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Section V

CAI STUDY

25 YEAR RE-REVIEW

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COMPUTER ASSISTED INSTRUCTION

1. Background

1.1 Computer Assisted Instruction (CAI) has been described as "a man-machine relationship in which the man is a learner and the machine is a computer system with the objective of human learning and retention." ^a While this is admittedly a very concise view of CAI it does paint an accurate picture of this new media.

1.2 Computers as teaching machines can present lesson materials and accept student responses, in several forms. The computer can type on an electric typewriter, generate visual and textual images on a TV screen, control external devices such as slide projectors and tape recorders, or respond through many other devices. In short, it is a highly versatile mechanism.

1.3 To many the level of research and development in CAI is compared to the first flight of the Wright brothers airplane. Like the airplane, however, great and far reaching effects on society are anticipated from CAI as it comes of age.

1.4 Like PAI or other new ideas it is sometimes quite difficult to note specifically a place in time where CAI began. No one person can ever assume more than a share of credit for its inception. As is the case of most "inventions" CAI is the cumulative work of many.

1.5 If one is willing to accept the argument that CAI is at least equally effective as Traditionally Administered Instruction (TAI) then one can accept that "... CAI cost, less than 10 years from now, including the development of (600) courses, will be roughly one-half the cost of comparable TAI." ^b

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^a Quotation attributed to [REDACTED]

^b "Computer Administered Instruction versus Traditionally Administered Instruction=Economics, " [REDACTED] RRO, 1967.

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2. CAI Systems

2.1 With this background we will briefly describe the present CAI systems in use and their potential to the field.

A. Drill and Practice Systems

This system, unlike TAI, does not provide a set pattern of tracks for the learner to follow in his practice session. Instead the degree of difficulty is chosen by the learner in his interaction with the computer. An example of this approach can be noted in attachment 12.

B. Tutorial Systems

The aim of this system is to literally replace the classroom teacher as the prime dispenser of basic information. Such a system allows for individual instruction based on the learner's need and not on the needs of his classmates.

C. Student-Computer Dialogue

This is a program designed to allow a dialogue between the student and the program. A system designed for greater self-direction with the system under the student's control. The student learns at his own pace and in his own approach to the final mastery of the subject.

3. Status of CAI Today

3.1 While the three basic systems described are fundamental to CAI they undoubtedly represent only the beginning of the possible "systems" in CAI. But what is the "state-of-the-art" in CAI?

3.2 Recent advances in the technology have made computers so easy to use that we now find them in elementary schools at first grade level. This advance has been possible mainly because of (1) new computer languages and (2) time-share principles.

These new developments have opened the range of possible CAI use and lower costs.

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3.3 Computers can, of course, be teaching machines. In fact most CAI systems today are programmed instruction courses in a more sophisticated form. These programs vary in their quality and may encompass any of the systems noted previously.

3.4 There are several CAI programmed lesson systems under development such as:

- A. Plato and Socrates - University of Illinois
- B. Statlab - System Development Corporation
- C. Coursewriter - IBM, University of Michigan
- D. Mentor - BBN
- E. Others under development

Most of the above systems are being used in colleges throughout the country mainly for experimental work.

3.5 With current CAI systems the instructor (programmer) programs the problems for the student. In doing so the programmer must take into consideration all possible sequences in the learning problem. Thus like PAI this form of CAI is self-limiting in the scope of student involvement because it asks and expects responses in the teacher (programmer) frame of reference. This is similar to the methods used by many live instructors.

3.6 The reverse of this approach and the system most likely to advance in the immediate future is one referred to as "language-programming" where the students use new algorithmic languages under development to facilitate human communication with computers. In short the student develops his own interaction with the program, instead of the confined teacher based program.

3.7 From these two major language approaches the future is for a blend of the teacher-programmed CAI and the student language CAI into an integrated form. In this advance form the teacher program would in effect monitor the student language responses, thus gaining the better parts of both. Unfortunately the technology of CAI has not yet reached this point.

3.8 There are still, of course, many unsolved technical problems with CAI today. These problems include such difficulties as (1) reliable and efficient hardware, (2) computer's ability to recognize

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the meaning of all sentences, (3) adequate software, and (4) the prime problem of pedagogical and psychological factors in education.

4. Cost

25X1 4.1 The question of cost is a very difficult problem to answer simply because the base upon which comparisons can be made is impossible to substantiate. For example, if we compare CAI cost to TAI cost we must make a host of assumptions regarding what a TAI cost is. We must also agree that both systems are at least equal in their ability to teach, etc. Problems which are not easy to resolve. The research paper on cost comparatives written by [redacted] previously cited in this study is perhaps the most comprehensive on this subject to date.

4.2 The use base upon which a cost comparative is made will also significantly affect the outcome. If, for example, we assume a given CAI installation was to be used for 1000 hours a year versus any other number the base cost would change. This "cost" includes hardware, software, programming, administration and maintenance of the system.

4.3 Perhaps the largest single cost at present would be the instructional programming cost. A cost that could exceed the equipment cost. But this is to be expected when the user is in effect writing a new "textbook" for one user only. In the immediate future experimental CAI work may be accomplished by utilizing existing CAI programs. Some of which are noted in Attachment 13.

4.4 In the final analysis the TAI costs per student hour in OTR must be calculated against the cost per CAI hour to determine the value of CAI to the Agency. Cost comparatives of this type are not possible at this time because of the complete lack of basic OTR cost data by this writer. For practical purposes, however, the future (next 5 to 10 years) holds out the promise of CAI costing \$1.00 per student hour. We must wait and see.

5. Conclusions

5.1 If the only argument to be made about CAI was one of economics the argument would probably stop now with "it costs too much." But monetary costs alone are not the sole criteria to judge CAI, PAI and any other media. The real test is the test of effectiveness.

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5.2 As noted in the brief analysis on instructional systems the key to the whole concept is the highly organized systematic development, analysis, implementation, and follow through on the system. Contrary to TAI this approach does not permit unstructured development. In fact CAI more than any other media demands a careful total systems approach. Even a moderately effective CAI system demands systematic integration of hardware, software, instructional strategy and content.

5.3 CAI has vast potential to OTR needs. It extends the possibilities for self-instruction beyond PAI and any instructional system currently known. It is clear that the problems of teaching discrimination or investigative problems in the Agency could be highly superior by CAI than by any other teaching method known today. (See Attachment 12 for an example of CAI investigative teaching.)

5.4 While PAI can adapt the instructional presentation to the gross characteristics of a specific individual, CAI can potentially adapt the instructional presentation not only to the detailed characteristics of the trainee but also his precise requirements of the moment.^c

5.5 The entire question of PAI vs. TAI or CAI vs. TAI is best summarized by the statement that "It must be always remembered that it is the instructional process that determines the efficiency of training; computer hardware and software are merely implements for setting a given process into motion."^d

6. Recommendations

a. The major question is how does CAI relate to the present and future needs of OTR. This question cannot be answered in isolation anymore than CAI can be utilized in isolation. The implementation of CAI must be accomplished in a systematic fashion. For this purpose the following five step development plan is recommended:

^c Ibid., page 22.

^d Ibid., page 22.

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CAI Development Plan

<u>Step</u>	<u>Action</u>	<u>Implementation Period</u>	<u>Estimated Cost</u>	<u>Fiscal Year</u>
1	Development, organization and implementation of course objectives.	Immediate. Should be accomplished in 6 months period.	I - \$50,000 E - \$10,000	FY '68 and each FY thereafter
2	Task analysis of each OTR course	Upon completion of step 1 above and action FY '68	I - \$50,000 E - \$20,000	FY '68
3	Development and implementation of PAI	Immediate upon completion of Steps 1 and 2	I - (manpower) E - \$50,000	FY '68 FY '69
4	Conduct a study on how, when and where CAI should be used in OTR, CIA as well as its cost	As soon as practical	I - \$10,000 E - \$50,000	FY '69 or FY '70
5	Implement step 4 findings	As soon as practical	I - open E - open	Open

Legend

I - Internal Cost (mainly labor cost)

E - External Cost (mainly consultant time)

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b. The preliminary work and cost of developing PAI is also the preliminary work required for developing CAI software. OTR's present and future programmers would therefore be the logical CAI programmers in the future. Because of the clear need to develop PAI, and to prepare for CAI, no time should be lost in implementing steps 1 and 2 of the recommendations with PAI and CAI in mind.

c. The estimated cost of implementing the various steps are in two levels: internal and external. The internal costs are such items as staff time, equipment, etc., whereas, external cost is mainly consultant and/or programmer time.

d. If the recommended plan is followed the development of CAI will occur as a natural progression from the development of PAI, allowing the Agency to be prepared for CAI in the near future.

e. The specific subject areas to be developed in the CAI format will also flow from the five step program outlined. The most logical topics would be those which are investigative or interrogative in nature.

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